

Mechanisms in implementation science: when the parts are greater than the sum

Elvin Geng MD MPH

Professor, Division of Infectious Diseases, Department of Medicine

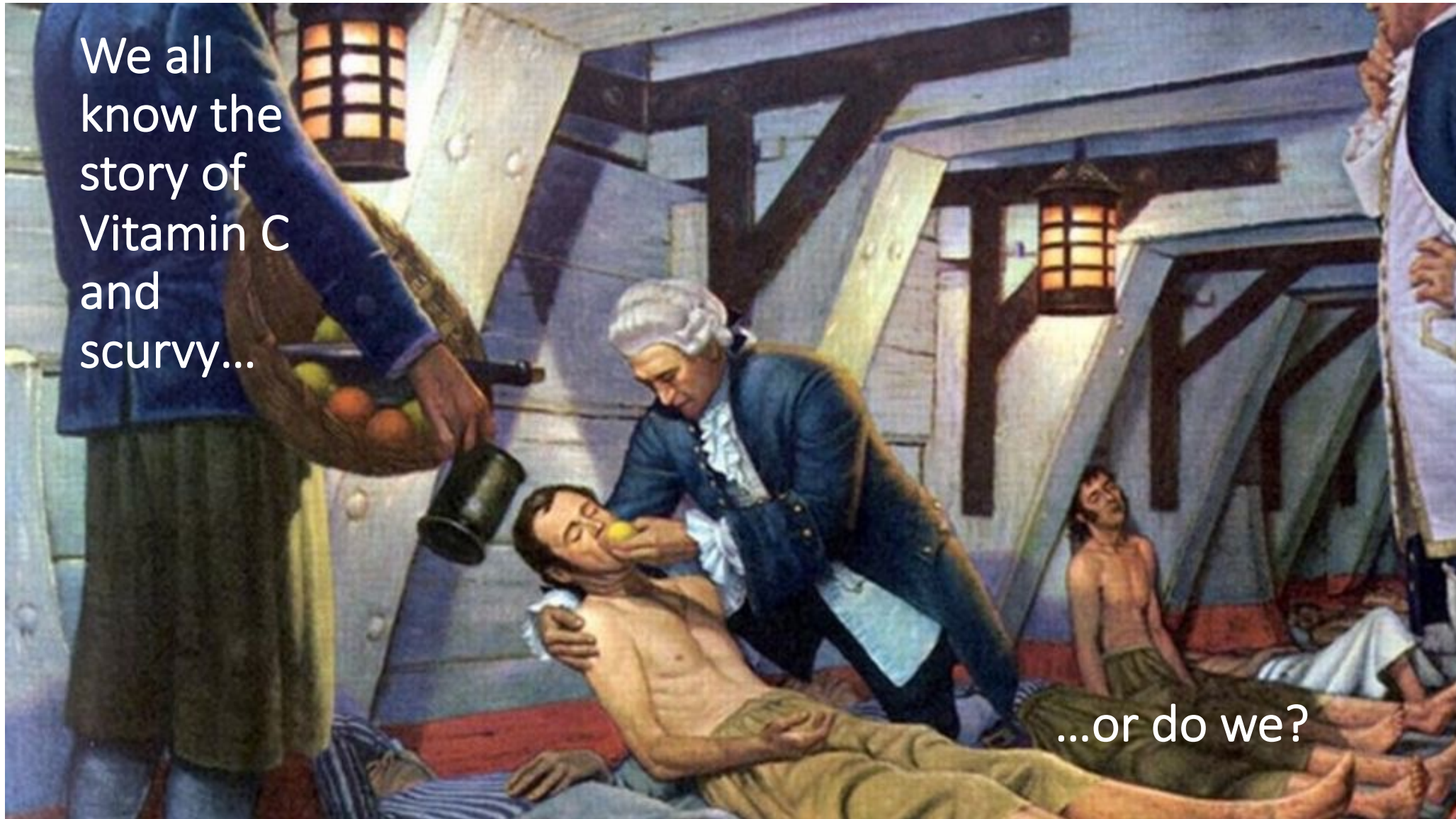
Director, Center for Dissemination and Implementation, Institute for Public Health

Washington University in St. Louis

Overview

- We want to know the effects of implementation strategies
- Contextual differences implies strategies do not have singular and invariant effects
- So instead of *whether* a strategy has effects, we want to understand when, where, how and under what conditions those effects occur
- How do we do so? Mechanisms play a necessary role
- Recommendations for implementation researchers

We all
know the
story of
Vitamin C
and
scurvy...



...or do we?

1747 James Lind's experiments uncovered the treatment for scurvy...

Elixir of Vitriol



Cider



Balsam of Peru



Vinegar



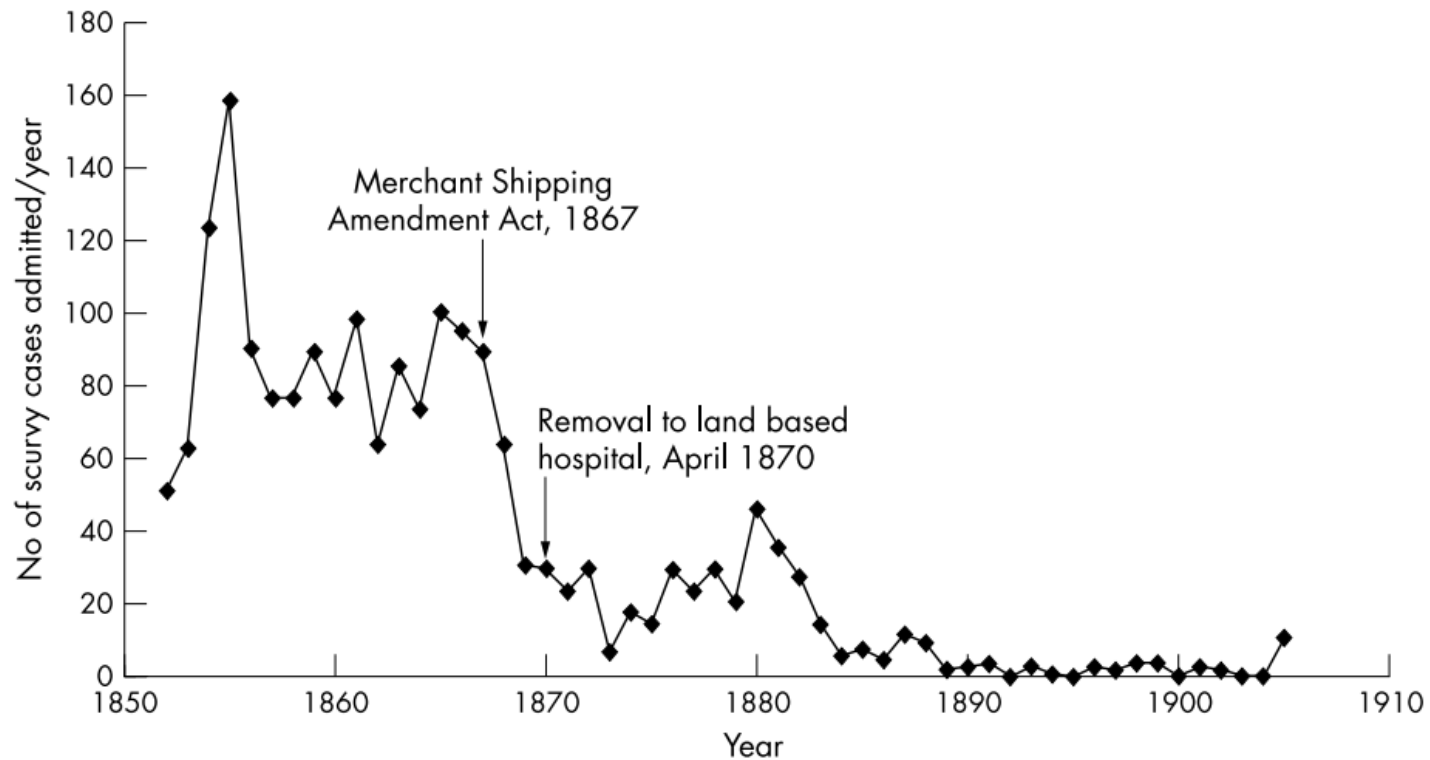
Sea Water



Citrus



But results were not taken up for 150 years, illustrating the know-do gap...



A
T R E A T I S E
O N T H E
S C U R V Y.

I N T H R E E P A R T S.

C O N T A I N I N G

An Inquiry into the Nature, Causes,
and Cure, of that Disease.

Together with

A Critical and Chronological View of what
has been published on the Subject.

By JAMES LIND, M. D.

Fellow of the Royal College of Physicians in *Edinburgh*.

The SECOND EDITION corrected, with Additions
and Improvements.

L O N D O N:

Printed for A. MILLAR in the *Strand*.

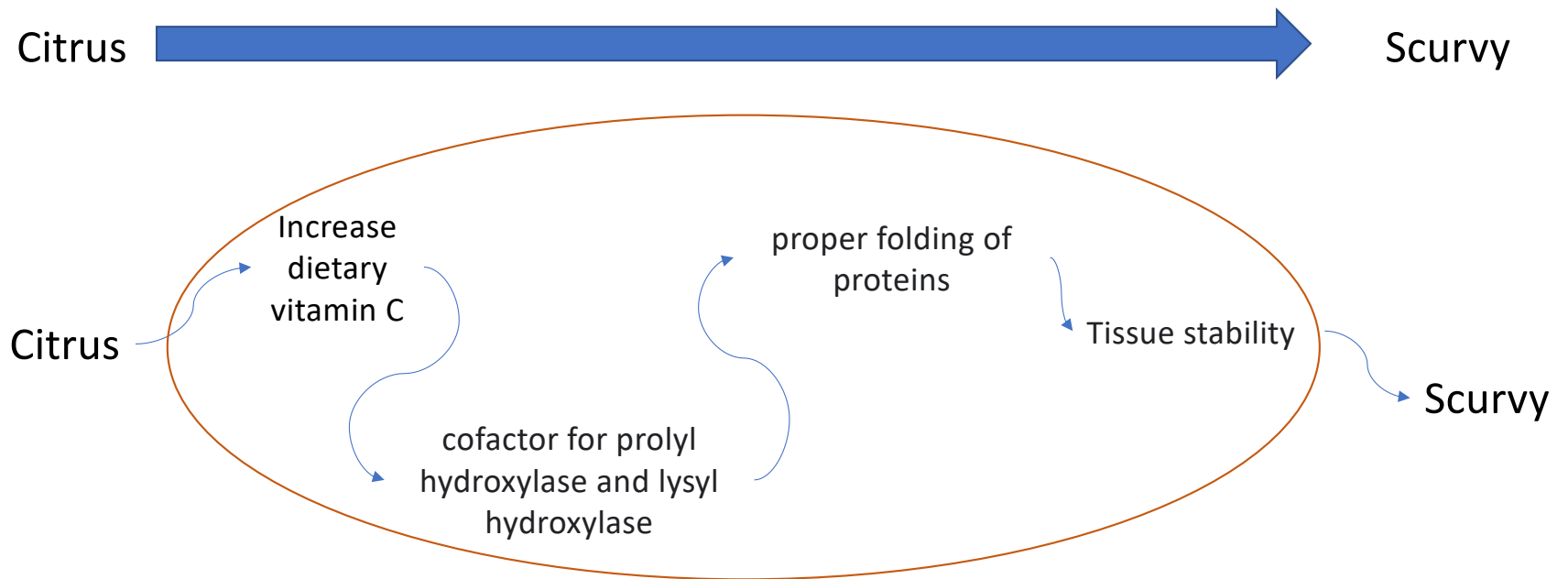
MDCCLVII.

...But is that the *real* story?

- Did not know the how citrus worked
 - Lemon juice was boiled, deactivating vitamin C
 - Cider also worked a little...
 - Lind did not order citrus when he headed a Navy Hospital
 - Died convinced he had not understood the disease
- This is not the a story of evidence that we failed to use...

...but a scientist that did not understand how it occurred, what it meant nor how to use it

How an effects occurs is the mechanism



Craver 2009

<https://plato.stanford.edu/entries/science-mechanisms/>

Mechanisms and implementation science

- How can mechanisms help us in implementation science (we're not interested in lemons, but rather things like facilitation)
- "Lind's Lessons" still apply
- The field has come to a shared understanding of a "strategy" and has begun to seek effects of strategies (when they occur)
- We need to understand *how effects happen*, to ensure that unlike Lind, we can apply the observations we are making
- What do I mean by apply?

#1: Mechanisms push us to think about causality

- Underappreciated contribution
- Causal pathways suggest dependencies that can be empirically examined
- Gives us coherence around what strategies are composed of and how they act
- Thus how they should be used
- Roadmap for research on implementation strategies

#2: Mechanisms help us generalize

- Will a strategy that worked in one setting work in another?
- Key question for *applying*
- Knowing mechanism will help answer that question
- Example: HIV treatment initiation (Amanyire Lancet HIV 2015)
- Mechanisms help us generalize by telling us what conditions in different context might influence effects

#3: Mechanisms help adaptation

- Understanding how a strategy works allow us to adapt to conditions
- Example
 - Knowledge brokering mechanism: rapport formation *enables* technical engagement
 - Adaptation: if rapport poor, then lengthen or intensify until you reach a certain threshold before starting technical activities (Sarkies PLoS Med 2022, Geng Plos Med 2022)
- Adaptive response requires understanding how knowledge brokering happens (i.e., the mechanism)

Tools and heuristics for thinking about mechanisms

- **Causal diagrams**

- Greenland S, Pearl J, Robins JM. Causal diagrams for epidemiologic research. *Epidemiology*. 1999 Jan 1;10(1):37-48.

- **Rothman's pies**

- Rothman KJ, Greenland S. Causation and causal inference in epidemiology. *American journal of public health*. 2005 Jul;95(S1):S144-50.

- **Selection diagrams**

- Bareinboim E, Pearl J. Causal inference and the data-fusion problem. *Proceedings of the National Academy of Sciences*. 2016 Jul 5;113(27):7345-52.

- **Mechanism mapping**

- Williams MJ. External validity and policy adaptation. *The World Bank Research Observer*. 2020 Aug 1;35(2):158-91.

Caveats and conclusions

- Caveats
 - Mechanism does not mean mechanical
 - Emergence might be lost
- Implications
 - Hypothesize about how implementation strategies work (and measure)
 - Understand contextual effects on those steps
- Develop a greater skill with our strategies and inform how to best use them